



## Course Specifications

<b>Course Title:</b>	Network Architecture Design
<b>Course Code:</b>	442 CNET-3
<b>Program:</b>	Bachelor in Computer and Network Engineering
<b>Department:</b>	Computer and Network Engineering
<b>College:</b>	Computer Science and Information Technology
<b>Institution:</b>	Jazan University

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## A. Course Identification

<b>1. Credit hours:</b> 3
<b>2. Course type</b> <b>a.</b> University <input type="checkbox"/> College <input type="checkbox"/> Department <input checked="" type="checkbox"/> Others <input type="checkbox"/> <b>b.</b> Required <input checked="" type="checkbox"/> Elective <input type="checkbox"/>
<b>3. Level/year at which this course is offered:</b> Level-9/ Year-5
<b>4. Pre-requisites for this course (if any):</b> 331 CNET-3 Computer Networks
<b>5. Co-requisites for this course (if any):</b> None

### 6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	52	100%
2	Blended	--	--
3	E-learning	--	--
4	Distance learning	--	--
5	Other	--	--

### 7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	22
2	Laboratory/Studio	22
3	Tutorial	--
4	Others (specify)	8
	<b>Total</b>	<b>52</b>

## B. Course Objectives and Learning Outcomes

### 1. Course Description

This course provides fundamental knowledge of network infrastructure design. Topics included in this course are strategies for planning, implementing and maintaining different technologies. The students will get familiar with optical networking which is latest technology used for providing network services. WAN protocols, Frame Relay and MPLS are introduced to design the network. This course also gives idea of network design model, Data Center Design.

## 2. Course Main Objective

This course will develop the students' ability to learn:

- Identify network design strategies and planning considerations.
- Design a network infrastructure according to the user requirements.
- Describe the network design methodology & network lifecycle.
- Describe the data center design and challenges in DC.
- Implement the WAN protocols Frame Relay & MPLS.

## 3. Course Learning Outcomes

CLOs		Aligned PLOs
1	<b>Knowledge and understanding</b>	
1.1	<b>Describe</b> various switching techniques and fiber optics communication.	K2
1.2	<b>Explain</b> different network media types to be used with different WAN protocols.	K2
2	<b>Skills:</b>	
2.1	<b>Apply</b> network design concepts and methodologies for WAN	S2
2.2	<b>Analyze</b> various network design models with protocols.	S5
2.3	<b>Demonstrate</b> different network design methods & data center components with its challenges.	S2
2.4	<b>Design</b> a Network for an enterprise or campus using various tools and techniques.	S3
2.5	<b>Communicate</b> effectively in group presentations to demonstrate their work.	S4
3	<b>Values:</b>	
3.1	<b>Encourage</b> designing a network solution with decisions favoring environmental and societal context.	V3

## C. Course Content

No	List of Topics	Contact Hours
1	<b>Chapter – 1: Fiber Optics Transmission</b> Introduction to Fiber-Optic Transmission Structure of Fiber- Optics Advantages & Disadvantages of Fiber-Optic Communication Mode in Fiber Optics <ul style="list-style-type: none"> <li>• Single-Mode in Fiber optics</li> <li>• Multi-Mode in Fiber Optics</li> </ul> Light Sources Photo Detectors Optical Modulation Direct Modulation External Modulation SONET <ul style="list-style-type: none"> <li>• SONET (Synchronous Optical Network) Network Architecture</li> <li>• Synchronous Optical Network Equipment</li> </ul>	4T + 4P

2	<p><b>Chapter – 2: Switching</b>  Switching and Why It Is Important?  Types of Switching</p> <ul style="list-style-type: none"> <li>● Switching of Physical circuits</li> <li>● Switching of Time Division Multiplexing signals</li> <li>● Cells/Packets Switching</li> </ul> <p>Packet Switching  Circuit Switching  Traffic Patterns</p> <ul style="list-style-type: none"> <li>● Benign Loads</li> <li>● Hotspot Loads</li> </ul> <p>Queues structures  Queuing Systems</p>	4T + 4P
3	<p><b>Chapter - 3: WAN Protocols</b>  Frame Relay (FR) Introduction  Frame Relay frame format</p> <ul style="list-style-type: none"> <li>● DLCI (Data Link Connection Identifier)</li> <li>● Data Link Connection Identifier Types</li> <li>● Discard eligibility</li> </ul> <p>Frame Relay Design  Congestion Control Mechanism  Advantages and Disadvantages of Frame Relay  MPLS</p> <ul style="list-style-type: none"> <li>● MPLS Mechanism</li> <li>● MPLS Tunnel Properties</li> <li>● Forwarding plane mechanisms</li> <li>● LDP (Level Distribution Protocol)</li> </ul>	4T + 4P
4	<p><b>Chapter - 4: Network Design Methodology</b>  Cisco Design Lifecycle (Network Life Cycle): Plan, Build, Manage:</p> <ul style="list-style-type: none"> <li>● Plan</li> <li>● Build</li> <li>● Manage</li> </ul> <p>PPDOO phases</p> <ul style="list-style-type: none"> <li>● Prepare</li> <li>● Plan</li> <li>● Design</li> <li>● Implement</li> <li>● Operate</li> <li>● Optimize</li> </ul> <p>Network Design Methodology</p> <ul style="list-style-type: none"> <li>● Identifying customer network requirements</li> <li>● Characterizing the existing network</li> <li>● Designing the network topology and Solutions</li> </ul>	4T + 4P
5	<p><b>Chapter – 5: Network Design Models &amp; Data Center Design</b>  Benefits of the Hierarchical Model  Hierarchical Network Design</p> <ul style="list-style-type: none"> <li>● Core layer</li> </ul>	6T + 6P

	<ul style="list-style-type: none"> <li>• Distribution layer</li> <li>• Access Layer</li> </ul> Hierarchical Model Examples <ul style="list-style-type: none"> <li>• Enterprise Campus Module</li> <li>• Enterprise WAN</li> </ul> Enterprise DC (Data Center) Architecture           Center Foundation Components <ul style="list-style-type: none"> <li>• Virtualization</li> <li>• Unified fabric</li> <li>• Unified computing</li> </ul> Data Center Topology Components           Challenges in the DC           Data Center Space           Enterprise DC Infrastructure           Data Center Storage	
	<b>Final Exam</b>	4T+ 4P
<b>Total</b>		<b>52</b>

<b>Online Study Topics :</b>
<ul style="list-style-type: none"> <li>• Optical Crossbar Switches</li> <li>• Digital Crossbar switches</li> <li>• WDM &amp; Its Capacity</li> <li>• Frame Relay Committed &amp; Excess information rate</li> <li>• Network Design Documents</li> <li>• Data Center Power</li> <li>• Data Center Heat</li> </ul>

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	<b>Knowledge and Understanding</b>		
1.1	<b>Describe</b> various switching techniques and fiber optics communication.	<ul style="list-style-type: none"> <li>➤ Lectures</li> <li>➤ Classroom discussions</li> <li>➤ Lab exercises</li> </ul>	<ul style="list-style-type: none"> <li>➤ Mid-Term Exam</li> <li>➤ Assignment 1</li> <li>➤ Final Exam</li> </ul>
1.2	<b>Explain</b> different network media types to be used with different WAN protocols.	<ul style="list-style-type: none"> <li>➤ Lectures</li> <li>➤ Classroom discussions</li> <li>➤ Lab exercises</li> </ul>	<ul style="list-style-type: none"> <li>➤ Assignment 1</li> <li>➤ Lab Exam</li> <li>➤ Final Exam</li> <li>➤ Mid-Term Exam</li> </ul>
2.0	<b>Skills</b>		
2.1	<b>Apply</b> network design concepts and	<ul style="list-style-type: none"> <li>➤ Lectures</li> </ul>	<ul style="list-style-type: none"> <li>➤ Mid-Term</li> </ul>

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	methodologies for WAN	<ul style="list-style-type: none"> <li>➤ Classroom discussion</li> <li>➤ Lab Exercises</li> </ul>	<ul style="list-style-type: none"> <li>Exam</li> <li>➤ Mini Project</li> <li>➤ Assignment 2</li> <li>➤ Final Exam</li> </ul>
2.2	<b>Analyze</b> various network design models with protocols.	<ul style="list-style-type: none"> <li>➤ Lectures</li> <li>➤ Classroom discussion</li> <li>➤ Lab Exercises</li> </ul>	<ul style="list-style-type: none"> <li>➤ Assignment 2</li> <li>➤ Mini Project</li> <li>➤ LAB Exam</li> <li>➤ Final Exam</li> </ul>
2.3	<b>Demonstrate</b> different network design methods & data center components with its challenges.	<ul style="list-style-type: none"> <li>➤ Lectures</li> <li>➤ Classroom discussion</li> <li>➤ Lab Exercises</li> </ul>	<ul style="list-style-type: none"> <li>➤ Assignment 2</li> <li>➤ Mini Project</li> <li>➤ LAB Exam</li> <li>➤ Final Exam</li> </ul>
2.4	<b>Design</b> a Network for an enterprise or campus using various tools and techniques.	<ul style="list-style-type: none"> <li>➤ Lectures</li> <li>➤ Classroom discussion</li> <li>➤ Lab Exercises</li> </ul>	<ul style="list-style-type: none"> <li>➤ Mini Project</li> <li>➤ LAB Exam</li> <li>➤ Final Exam</li> </ul>
2.5	<b>Communicate</b> effectively in group presentations to demonstrate their work.	<ul style="list-style-type: none"> <li>➤ Classroom discussion</li> <li>➤ Lab Exercises</li> </ul>	<ul style="list-style-type: none"> <li>➤ Lab Exam</li> <li>➤ Mini Project</li> </ul>
<b>3.0</b>	<b>Values</b>		
3.1	<b>Encourage</b> designing a network solution with decisions favoring environmental and societal context.	<ul style="list-style-type: none"> <li>➤ Lectures</li> <li>➤ Classroom discussion</li> </ul>	<ul style="list-style-type: none"> <li>➤ Lab Exam</li> <li>➤ Mini Project</li> </ul>

## 2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Assignments / Mini Project	4 <sup>th</sup> Week	20%
2	Midterm Exam	6 <sup>th</sup> Week	20%
3	Lab Exam	11 <sup>th</sup> Week	20%
4	Final Theory Exam	12 <sup>th</sup> Week	40%

\*Assessment task (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

Department have an arrangement for “Academic Counseling and Support” for each student. The academic advising committee nominates faculty members as “**Student Academic Advisor**” every semester. These “**Academic Advisors**” are responsible for student counseling and advising to a group of fix number of students (around 15 students) and maintaining students’ files. At the beginning of semester and at time of course registration all students take counseling from Academic Advisor according to his previous grades and coverage of pre-requisite course and follow-up. Also students with GPA below 2.00 are remained under deep observation and continuous meetings with respective course teachers about their performance are arranged to help and support the students. The course teacher is to be associated with this course provide a proper guidance for students who are looking to focus on their future career based on their intellectual interests, identify better opportunities related to this course and connections in their academic fields.

## F. Learning Resources and Facilities

### 1. Learning Resources

<b>Required Textbooks</b>	<ul style="list-style-type: none"> <li>• Krzysztof Iniewski, Carl McCrosky and Daniel Minoli “Network Infrastructure and Architecture, Designing High-availability Networks”, Wiley, 2008, ISBN: 9780471749066</li> <li>• Anthony Bruno , Steve Jordan “CCDA 200-310 Official Cert Guide” 5th Edition, 2016, Cisco Press, ISBN-13 : 978-1587144547</li> </ul>
<b>Essential References Materials</b>	<ul style="list-style-type: none"> <li>• Ina Minei and Julian Lucek, “MPLS-Enabled Applications “ 3rd Edition, Wiley, 2011. ISBN-13: 978-0470665459</li> </ul>
<b>Electronic Materials</b>	<ul style="list-style-type: none"> <li>• <a href="https://www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Borderless_Networks/Unified_Access/Unified_Access_Book/UA_Design.html">https://www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Borderless_Networks/Unified_Access/Unified_Access_Book/UA_Design.html</a></li> <li>• <a href="https://www.cisco.com/c/en/us/products/ios-nx-os-software/multiprotocol-label-switching-mpls/index.html">https://www.cisco.com/c/en/us/products/ios-nx-os-software/multiprotocol-label-switching-mpls/index.html</a></li> </ul>
<b>Other Learning Materials</b>	--
<b>Self Study</b>	

### 2. Facilities Required

Item	Resources
<b>Accommodation</b> (Classrooms, laboratories, demonstration rooms/labs, etc.)	Classroom equipped with projector and whiteboard and sufficient seating arrangements. Lab with software installed and individual computer terminal for each student.
<b>Technology Resources</b> (AV, data show, Smart Board, software, etc.)	Whiteboards and projectors for classroom and lab Following software for lab work: <ul style="list-style-type: none"> <li>• Cisco Packet Tracer 8.1</li> <li>• GNS3</li> </ul>
<b>Other Resources</b> (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	None

## G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Sufficiency of resources and facilities for students	Students	Course evaluation survey form
Effectiveness of teaching / learning process	Students	Course evaluation survey form
Effectiveness of teaching / learning process	HoD / QAU	Course reports / result analysis



Evaluation Areas/Issues	Evaluators	Evaluation Methods
Quality of learning Resources	Track leaders	Review meetings and star rating with suggestions for further modification and improvements
Verifying standards of student achievement / evaluation	HoD / committee nominated by HoD	Random re-checking of evaluated answer sheets
Achievement of course learning outcomes	Course Teachers and Course Coordinator / HoD	CLO assessment template that is further verified at course coordinator, Track leader and QAU level.

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

<b>Council / Committee</b>	DEPARTMENT COUNCIL
<b>Reference No.</b>	
<b>Date</b>	